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A MICRODEVICE FOR RAPID APPLICATION OF TOXICANTS TO INDIVIDUAL INSECTS

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In the topical application of reproducible amounts of toxicants to individual insects accuracy is the most important requirement, but ease and rapidity of the operation are also desirable. Trevan (2) proposed the use of a micrometer to actuate a glass syringe for measuring small volumes of liquids. Although this device is reasonably accurate, the operator is required to read the micrometer and at the same time devote his attention to each individual test organism. March and Metcalf (1) described a similar device with a spring attachment which acts as a click micrometer. It requires less attention from the operator in determining the volume delivered, but as the micrometer thimble advances towards its inner limit the spring tends to drag and incorrect amounts may be indicated.

The instrument described here makes use of a positive-action ratchet which advances the micrometer spindle as a control lever is moved through a predetermined arc; in this way the possibility of errors due to improper micrometer readings is eliminated.

The dimensions of this device, shown in figure 1, may vary with the type of micrometer selected. The micrometer frame is cut off at a point J, so that the syringe holder (K) and the micrometer can be mounted along the same longitudinal axis, with the ends of the syringe plunger and the micrometer spindle in juxtaposition at I. The syringe is fitted with either a hypodermic needle for injection or a similar needle with the point ground off square and bent at a 90° angle for topical applications. The ratchet wheel (C) may be turned from brass or any other suitable metal. It is secured to the micrometer thimble (D) by a friction fit. The ratchet grooves are machined so that the

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1/ The authors acknowledge the work of the N. Shestopal Machine Shop, Honolulu, T.H., in perfecting the ratchet-drive mechanism, and that of workers in various laboratories who have contributed their ideas in the design of such an instrument.

leading edges are equivalent to and opposite the divisions on the micrometer thimble. The ratchet wheel is machined with offset shoulders, which act as bearings for the control lever (H). This lever carries the ratchet pawl (G), which with its spring exerts enough pressure on the micrometer thimble to insure its movement during the down stroke of the control lever. The end of the pawl slides over the surface of the ratchet wheel during the up stroke of the control lever when the ratchet wheel is held stationary by the ratchet stop (B). This stop, which rides on the ratchet wheel with the pressure of spring A, prevents the wheel from rotating when the control lever is raised. The adjustable upper stop (E) and the fixed lower stop (F) determine the arc through which the control lever moves, and thus the amount of forward motion of the spindle.

The control lever moves forward with the micrometer thimble as the device is operated, since it has as its bearings the offset shoulders of the ratchet wheel. The rachet stop and spring also slide forward on appropriate supports. To reset the micrometer the ratchet pawl is disengaged by pulling the handle back into the slot in the control lever and the ratchet stop is raised and slipped to its outer limit. The pawl and stop are then replaced.

The accuracy of the modified micrometer mechanism depends on that of the micrometer and also on the accuracy with which the ratchet grooves are machined into the ratchet wheel. The major limiting factor in the accuracy of delivery is the uniformity of the bore of the syringe.

A 0.25-ml. glass syringe was calibrated with the ratchet-driven micrometer with triple-distilled mercury as a calibrating medium. The results of these tests indicated that, within the same region of the syringe, an advance of 0.005 inch of the micrometer spindle delivered from 0.97 to 0.99 microliter through a 27-gage hypodermic needle. Since a volume of about 1 microliter was desired, the adjustable upper stop was set so that the movement of the control lever advanced the micrometer spindle 0.005 inch. The volumes delivered from various regions of the syringe ranged from 0.95 to 1.13 microliter. Variation in syringes may make it desirable to calibrate each one for accurate work and to adjust the upper stop (E) so as to deliver comparable volumes from the different syringes.

Literature Cited

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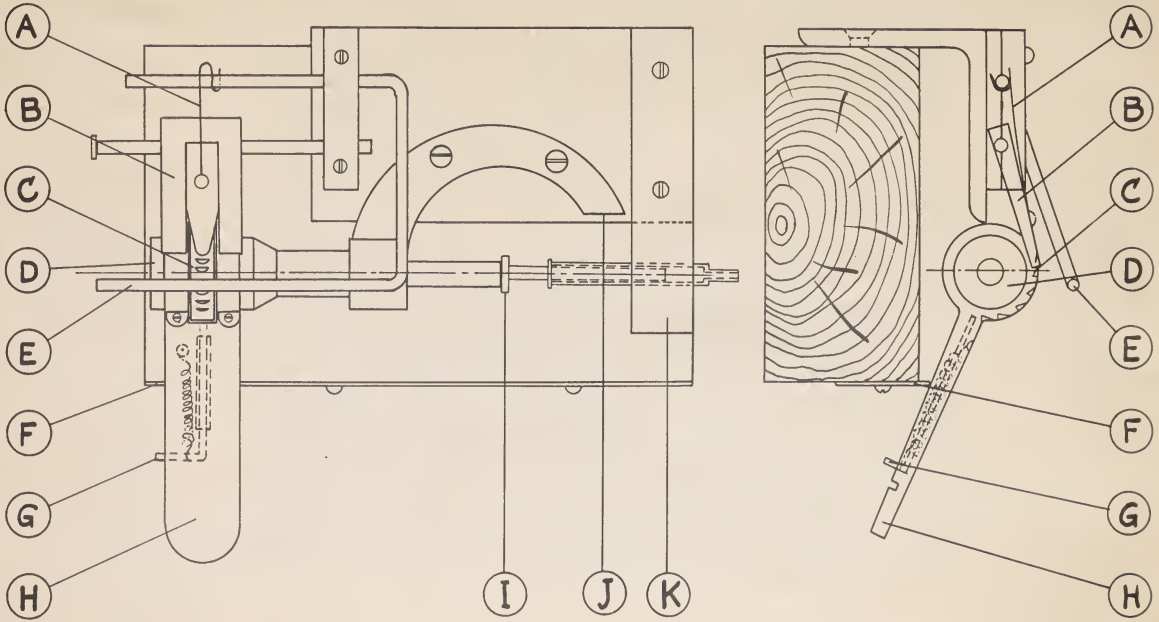

Figure 1.--An automatic micropipette consisting of a ratchet-driven micrometer and a 0.25-ml. glass syringe.

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